The Kachemak Bay Research Reserve Nearshore Oceanography Program

KACHEMAK BAY RESEARCH RESERVE
ALASKA DEPARTMENT OF FISH AND GAME
2181 KACHEMAK DRIVE
HOMER, ALASKA 99603

By
Katie Gaut and Carl Schoch
(contact: katie_gaut@fishgame.state.ak.us)

Introduction

The Kachemak Bay Research Reserve is one of 25 National Estuarine Research Reserves (NERRS) participating in the System-Wide Monitoring Program (SWMP) for the National Oceanic and Atmospheric Administration (NOAA). The goal of SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds. To accomplish this, each reserve has a minimum of 2 water quality monitoring sites.

Methods

YSI instruments have been deployed since July of 2001 on the ferry docks in both Homer and Seldovia (Figure 1A and 1B). The Seldovia instrument monitors the currents of Kachemak Bay entering from the southwest (Figure 2, see right). The Homer instrument is deployed in the path of a current leaving the inner bay. This current is largely composed of less saline, turbid glacial melt and runoff from the surrounding uplands. In addition, nutrient samples and weather data are gathered from each site. The patterns of data shown by this monitoring equipment will increase our understanding of how Kachemak Bay functions and changes naturally over time. This will eventually allow us to predict how this marine system responds to changes in climate and human-induced perturbations.

Figure 1A. A YSI 6600 Sonde is an electronic instrument with a series of sensors that measure turbidity, pH, salinity, temperature, depth, dissolved oxygen concentration, chlorophyll-A, and solar radiation.

Figure 1B. The YSI 6200 Data Acquisition System relays the 15-minute data collected from the 6600 Sonde to our office computer via phone modem every hour.

Analysis

The time series data streaming into our computers are screened in real-time for errors and gaps. This quality control procedure allows us to respond to instrument failures and to schedule the frequency of routine re-calibrations (Figure 3). Once per month the data are analyzed using Matlab software to produce graphs and basic statistical summaries.

Figure 3. A diver examines and cleans a PAR sensor at the Seldovia site (left). Instrument maintenance is supported by our research skiff (right).

Results

Initial results have already begun to show how winds and tides affect Kachemak Bay. The NDBC marine weather buoy data shows patterns strongly influenced by the seasons (Figure 4), and the prevailing wind direction as shown in Figure 5. Warm and cool water masses flowing into Kachemak Bay can be seen passing the NDBC site on Figure 6, then the southern edge of the Bay along the Seldovia site, and finally the northern edge by the Homer site. The time lag between sites is approximately 4 days. The influence of fresh water is shown on Figures 7A and 7B.

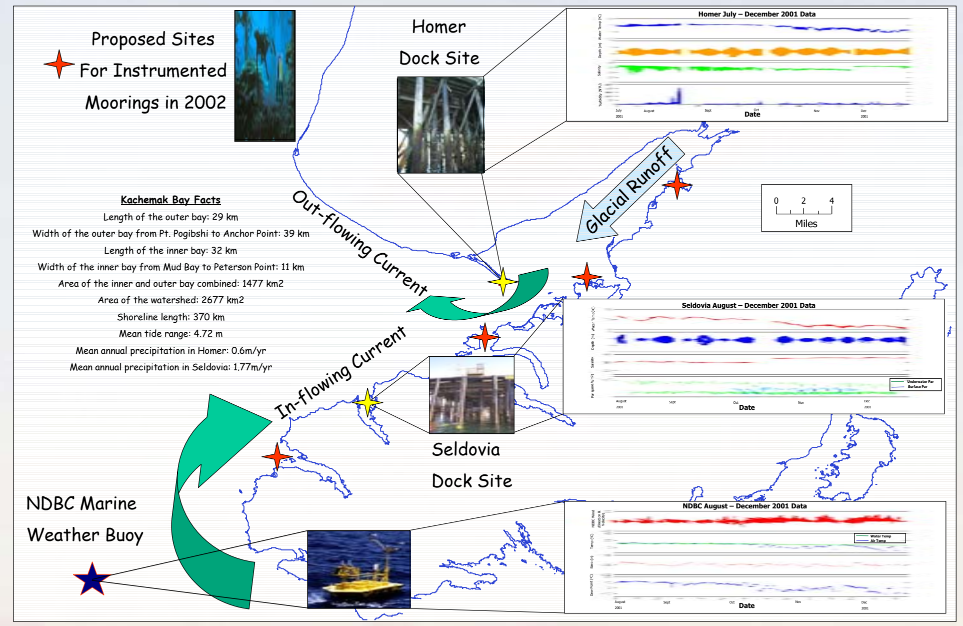


Figure 2. This map of Kachemak Bay illustrates where instruments are now and where we plan future deployments. Arrows indicate the primary direction of water flow into and out of the Bay.

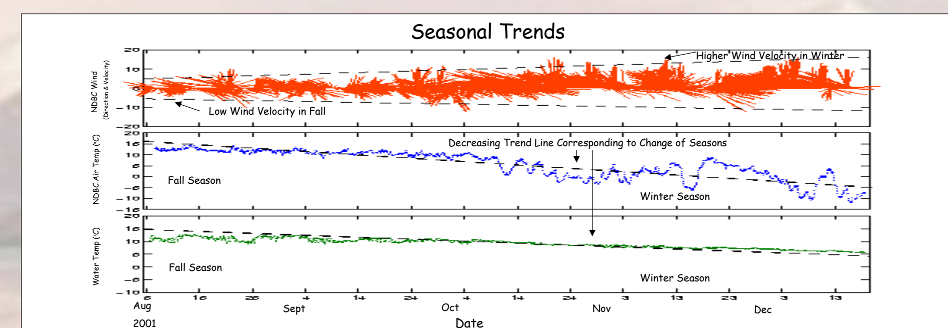


Figure 4. Seasonal patterns are indicated by a decrease in air and water temperatures. The feather plot at the top of the figure is a derivative of wind direction and wind velocity. Wind velocity tends to increase from fall to winter. Each vector indicates the direction the wind is coming from.

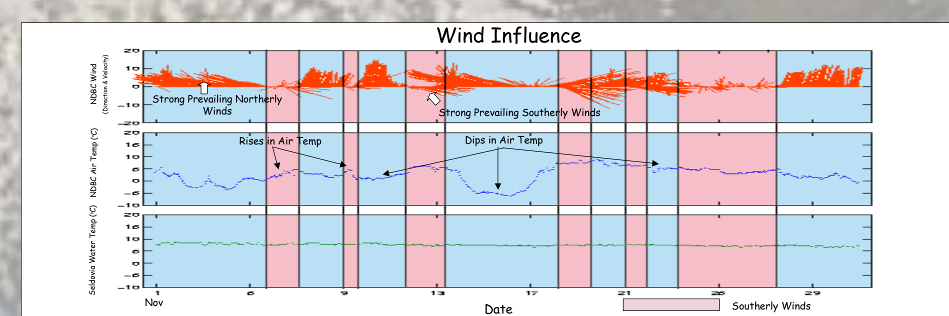


Figure 5. Directional wind trends are indicated by the color-shaded areas. The blue bars represent periods of northerly winds. In November, these winds cause a decrease in air temperature as the relatively cold continental air mass displaces the maritime air mass as shown on the center plot. The lower plot shows the water temperature at Seldovia which remains relatively constant indicating that the water column is well mixed.

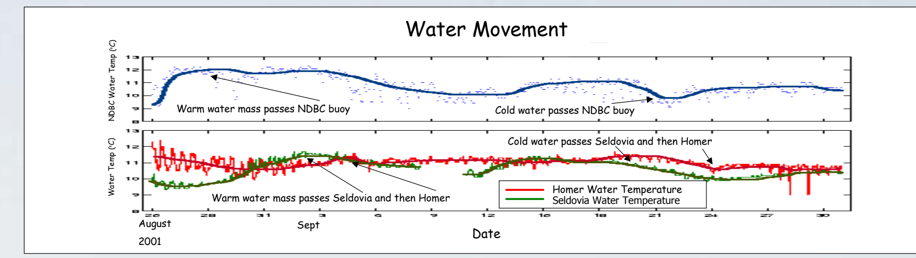
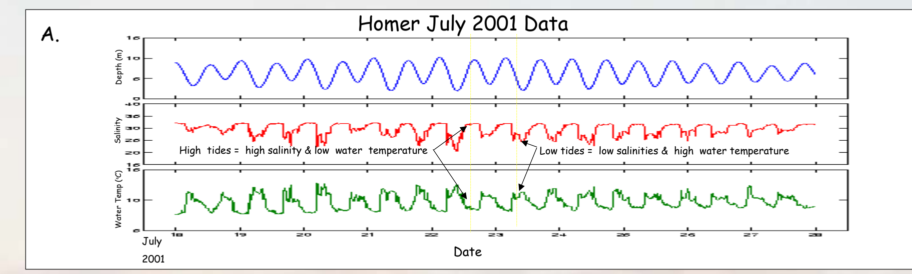


Figure 6. These plots illustrate the relative water temperatures at the 3 sites. An oscillating pattern is observed as cold and warm water masses enter the Bay and pass by the NDBC buoy, then continue moving along the south coast past Seldovia, and finally are observed along the north coast near Homer.



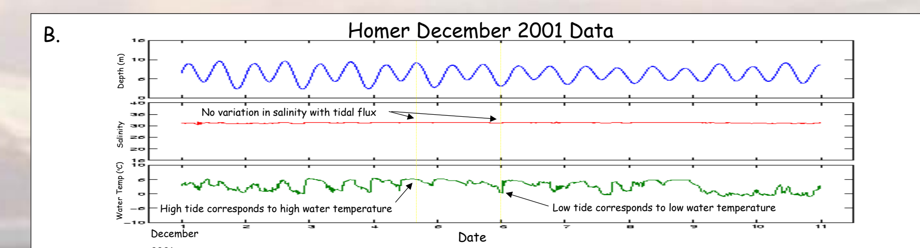


Figure 7A&B. The strong influence of watershed and glacial runoff is shown on these plots. In the summer, a strong correlation between tidal height, salinity and water temperature is evident as the instrument detects the stratified water column (Figure 7A). During the winter months, when glacial runoff is at a minimum and the watershed is mostly frozen, the stratification of the water column first weakens and then disappears (Figure 7B). This is illustrated with relatively constant salinities between high and low tides. However, water temperature fluctuations are still measured between the highest and lowest tides.

Discussion

These data support the general observation that there are different seasonal circulation patterns in the Bay. During the summer months when the fresh water surface stratification intensifies, there appears to be a relatively constant surface current flowing out of the inner bay. A recent drift card study suggests that this net outflow of fresh water may deflect surface water from the outer bay towards the west and north. Further work with drift cards during the winter may show that a decrease in fresh water runoff in the inner bay will allow surface water from the outer bay to continue inside of the Homer Spit.

These data and our studies of circulation patterns in Kachemak Bay will improve our understanding of how this system functions, what processes drive food production and distribution, where marine organisms that follow ocean currents come from, and where they go.